THE IMPACT OF THERAPY BALLS ON EXECUTIVE FUNCTIONING AND BEHAVIOR IN THE CLASSROOM

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A dissertation to fulfill the requirement for a

DOCTOR OF PSYCHOLOGY IN COUNSELING PSYCHOLOGY

at

NORTHWEST UNIVERSITY

2015

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Abstract

The purpose of this dissertation is to determine the impact on children's executive functioning and self-esteem when therapy balls are used in the classroom instead of traditional seating. An experimental, within subject design was implemented using 44 children. There were six assessments: the Behavioral Rating Inventory of Executive Functioning (BRIEF) scale, two scales of the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV), the Culture Free Self-Esteem Inventory -Third Edition (CFSEI-3), a questionnaire regarding students' peer relations, and a student and teacher questionnaire regarding preference of chairs versus therapy balls. The results showed that children significantly improved in working memory and processing speed as measured by the WISC-IV. Furthermore, the children displayed significantly reduced hyperactivity-impulsivity and improved monitoring abilities as measured by the BRIEF. Children also significantly improved in self-esteem as measured by the CFSEI-3. Despite these developments, teachers rated the children as having improved minimally, not significantly, in attention. There were no significant gender findings. Additionally, the children preferred therapy balls over chairs, but the teachers did not. Finally, where past research mainly revealed students with attention deficit hyperactivity disorder (ADHD) or autism spectrum disorder (ASD) benefitting most from therapy balls, this study showed that typical and atypical children significantly improved. Ultimately, this study has shown that classrooms can be modified to give all children more liberty of movement while seated at their desks, resulting in more optimal learning, and improved self-esteem.

Keywords: therapy balls, attention, hyperactivity-impulsivity, working memory, processing speed, self-esteem

Acknowledgements

We have a brain because we have a motor system that allows us to move away from danger and towards opportunity. Educational systems that reduce most student movement to one appendage, writing sequences of letters and digits on a playing field the size of a sheet of paper, don't understand the significance of motor development. - Dr. Robert Sylwester

Thank you to my brilliant and patient husband, Jim DuBois, you always took time to answer my never-ending questions and countless requests for edits. Your encouragement to pursue psychology was the instigator of my journey and your continual support brought me through to the end. I love you!

To my oldest daughter, Dani Erickson, I'll never forget the sacrificial weekend of edits when your proficiency helped me master my literature review. To my middle daughter, Dominique DuBois, your research assistance brought me peace and comfort when I needed it most. And to my youngest, David DuBois, my toddler who became a tween while I was writing, your healthy zest for life and creative passions helped me create a vision, too.

To my dissertation committee, Dr. Sarah Drivdahl and Dr. Kim Lampson, thank you for your support and expertise. And to Dr. Becky Sherman, I think God knew you would be the perfect fit for me as a Chair. Your beautiful balance of honesty and encouragement kept me focused and moving.

To my parents, Kendall Turner and Adele Slind, thank you for believing in me from the beginning.

Finally, to my God, I remember sitting in church wondering about my gifts, and how to apply them—if I could even grasp what they were. You answered.

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Chapter 1

The prevalence of certain neurodevelopmental disorders in children has been increasing over the last two decades (Schilling & Schwartz, 2004; U.S. Department of Education, 2013; U.S. Environmental Protection Agency, 2013; Visser et al., 2013). This finding translates into behavioral and social problems, posing difficult challenges to parents and children (Barkley, 2002; Dole & McMahan, 2005; Loe & Feldman, 2007; Massetti et al., 2007). Educational issues for these children arise as well (Barkley, 2002; Dole & McMahan, 2005; Loe & Feldman, 2007; Massetti et al., 2007). Special education and individualized education programs (IEPs) are used as the main interventions to assist these children; yet due to the intensity of intervention, not all schools are equipped to make these programs successful (Schilling & Schwarz, 2004). Class sizes are often too large for teachers to customize individual learning programs (Keefe, Moore, & Duff, 2004). Furthermore, many charter and private schools do not offer appropriate special education programs due to inadequate resources (Fiore, Harwell, Blackorby, & Finnigan, 2000). Often, these underserved children with hyperactivity or inattentiveness issues become disruptive, showing behavioral problems which are reprimanded in the classroom (Kercood & Banda, 2012). This pattern results in feelings of insecurity along with an intensified sense of alienation, and plummeting self-esteem (Leroux & Levtt-Perlman, 2000).

Whether in mainstream classrooms or private schools, these students may be at risk for not growing into their true academic potential (Alexander, Entwisle, & Dauber, 1993; Bradshaw, Zmuda, Kellam, & Ialongo, 2009; Entwisle, Alexander, & Steffel Olson, 2005; Leroux & Levtt-Perlman, 2000). These are the children who do not always pay attention in class, who may have unruly conduct due to hyperactivity and impulsivity, and who might even be gifted intellectually (Leroux & Levtt-Perlman, 2000), yet perform poorly on standardized tests (DuPaul et al., 2006; Loe & Feldman, 2007). Realizing that they are different, their self-esteems may be lowered, feeling as if they do not belong (Dole & McMahan, 2005; Frankel, Cantwell, Myatt, & Feinberg, 1999). They are in the margins of the educational system, not fitting well into the routine and structure of a normal classroom environment, but also in some scenarios, not able to take advantage of specialized classes due to a variety of reasons (Leroux & Levtt-Perlman, 2000). However, there may be other ways to meet these children's needs.

Literature Review

With the ultimate desire being to assist children, parents, and educators, this section will illuminate the current research pertaining to elementary children and the classroom environment. Initially, the prevalence of neurodevelopmental disorders and how they are manifested in children, ultimately affecting parents and educators will be discussed. Next, the Optimal Stimulation theory will be discussed which may shed information on why children are struggling. Then, current research on therapy balls in the classroom will be reviewed, focusing on executive functioning, self-esteem, and gender.

Neurodevelopmental disorders. Of the 5.7 million children receiving special education services, 42 percent have learning disabilities (Cortiella & Horowitz, 2014). A specific learning disorder diagnosis requires a child to display persistent difficulties in reading, writing, arithmetic, or mathematical reasoning skills during formal years of education. Symptoms may include inaccurate, sluggish and effortful reading, written expression that lacks clearness, difficulties memorizing number facts, or inaccurate mathematical reasoning (Cortiella & Horowitz, 2014). Beside the high number of specific learning disorders, other neurodevelopmental disorders are on the rise: 2 million more children were diagnosed with attention deficit hyperactivity disorder (ADHD) in 2011 than were diagnosed in 2003 (Visser et al., 2013).

Moreover, the number of children diagnosed with autism spectrum disorders (ASD) is also increasing (Bartley, 2006). In 2000-2001, 94,000 children were listed with ASD; by 2010-2011, this number has increased by approximately 344% (U.S. Department of Education, 2013).

It is not completely known why the incidence of these neurological disorders are increasing. Some believe it is due to increased awareness about these disorders; therefore ADHD symptoms are more easily recognized, resulting in increased diagnoses (Swanson, Lerner, & Williams, 1995). Others believe childhood learning difficulties are growing as a result of multitudes of children spending an abundance of time watching TV during their developing years (Johnson, Cohen, Kasen, & Brook, 2007). Research shows that, other than sleeping, watching TV is the most prominent activity in the home (United States Department of Labor, 2007). In one study, youth who watched three or more hours of TV per day were at higher risk for subsequent attention problems and learning difficulties, and were also the least likely to attend vocational school or college after high school (Johnson et al., 2007). In today's home environments, smartphones, iPads, Xbox console games, and computers are highly accessible. Historically, spending time in front of an electronic screen may not have been problematic. Now, however, with the increased sophistication in technology presentation and large influx of time in front of an electronic screen, children's developing brains are being trained to expect intense stimulation

(Christakis, 2009). This type of exposure may be making it more difficult to concentrate in environments, such as the classroom, that do not match the energy level displayed in TV shows (Christakis, 2009). When compared to the pace with which real life unfolds, TV shows, particularly directed at children, employ swift scene changes and quick edits. This engages children's orienting response, the natural reflex that focuses attention on strange sounds or sights, ultimately, keeping them fixated on the screen (Christakis, 2009). These powerful visuals may be over-stimulating to developing brains. In essence, children are being accustomed to and are expecting intense input, making reality boring by comparison (Christakis, 2009). Listening to the teacher or working on math assignments may not compare to the stimulation received from watching fast-paced action programs. These 21st century realities may be contributing to children's learning disorders, such as ADHD, which are becoming problematic in the classroom. Inattentiveness ultimately affects academic performance, posing new challenges for schools (Schilling et al., 2003).

Education system. With the U.S. education system now falling to the rank of 17th in the world in cognitive abilities and education level attainment (Unit, Economist Intelligence, 2012), it is apparent that the system should adapt and change in order to meet the needs of a changing population. With increasing symptoms of hyperactivity (Visser et al., 2013), as well as indicators of other more serious disorders, special education is one way administrators have attempted to address the deficits found in children with neurodevelopmental disorders. But what about children who do not have access to special education classrooms? Some children with learning challenges do not qualify or for other reasons do not participate in the special education system. Their learning disorder may go unnoticed for many years, or their parents may be in denial of a potential developmental issue, not wanting to come to terms with the possibility that their child may not be typically developing. Since the Education for All Handicapped Children Act became law in 1975, individualized education programs (IEPs) have been used widely and considered a cornerstone in the special education program (Drasgow, Yell, & Robinson, 2001). Yet, these services bring their own set of challenges; sometimes unclear guidelines with IEPs have led school districts to make mistakes and not fully meet the children's needs (Drasgow et al., 2001; Powers et al., 2005). Additionally, with large class sizes, it appears time-consuming for teachers to track, customize, and enforce strategies that apply to only some children (Keefe et al., 2004).

Teachers are not the only people affected by these barriers (Keefe et al., 2004). Dissatisfaction with the public school system has driven many parents to use charter and private schools (Fiore et al., 2000). Regarding special education, charter schools must follow the same federal and state laws public schools are required to, yet some are falling short (Fiore et al., 2000). Many parents who left public schools in search of better programs at charter schools, are still reporting a loss of special education services in general (Fiore et al., 2000). Moreover, if parents, instead, choose attendance at a private school for their children, they also run into barriers. Many private schools are not equipped with special education classes to assist children in this population and are not mandated by law to do so (Christensen et al., 2007).

Optimal Stimulation theory. As much as educators and parents want to implement special education programs and IEPs to assist children—often blaming children's excessive energy on disorders such as ADHD—there could be another factor involved in their behavior. Could some of the labeling of these disorders be due to the classroom environment? Sitting in classroom chairs unable to move is a challenge for many children, whether diagnosed with a learning disorder or not (Kercood & Banda, 2012). Whenever one must stay in an idle position for a lengthy period of time, it is not unusual to feel fidgety (Kercood & Banda, 2012). This may be due to the Optimal Stimulation theory, derived from the works of Hebb (1955) and Leuba (1955), suggesting that people naturally seek a level of stimulation suitable to their individual needs (Joachimsthaler & Lastovicka, 1984; Schilling et al., 2003; Wachs, 1977). Furthermore, because the body experiences less proprioceptive and kinesthetic feedback when it is stagnate, there may be decreased attention due to a state of under arousal (Pfeiffer, Henry, Miller, & Witherell, 2008). Prioceptors are sense organs that send information to the brain regarding muscle position, tension, and equilibrium (Hannaford, 2005). General observations of children show that children tend to learn when the environment is novel and exciting (Antrop, Roeyers, Oost, & Buysse, 2000; Leuba, 1955; Zentall, 1975). They often try to get as much stimulation as possible out of their environment. If the environment is lacking stimulation and a child is forced to be stagnate, this child will initiate activity, such as tipping back on a chair, in order to reach a stimulatory state of homeostasis (Schilling et al., 2003).

On the opposite spectrum, children who find classroom noise or other external stimuli too overwhelming rely on innate, soothing bodily movements, such as rhythmic rocking, to bring themselves to a calmer state (Zentall, & Zentall, 1983). In both scenarios, freedom to move is important; yet from an early age, children are told not to move their bodies during classroom time (Hannaford, 2005). During normal school settings, children are often punished for what seems to be an instinctual, natural motivation to move. Out of seat behavior and excessive fidgeting is deemed unruly and can lead to disciplinary procedures (Kercood & Banda, 2012). According to Leroux and Levitt-Perlman (2000), the U.S. educational environment was not designed for an active child; this breeds restlessness and misbehavior, which morphs into conduct defiance or attempts at challenging authority figures. When children are restless and acting out, attention-spans are thwarted, resulting in decreased learning (Hannaford, 2005) and participation in classroom activities (Bagatell, Mirigliani, Patterson, Reyes, & Test, 2010). Moreover, what people focus on is directly linked to the majority of what people perceive (Hannaford, 2005). Students may only absorb minimal academic content when they cannot pay attention (Hannaford, 2005). While the Optimal Stimulation theory could partially explain some of the fidgetiness witnessed in children, overall low physical activity may also play a role. In a study on children with ADHD, participants displayed reduced impulsivity and improved cognitive response time after physical activity (Medina et al., 2010).

Therapy balls. Since traditional classroom settings in America have primarily remained unchanged over the years, children sit at desks for long periods of time listening to their teachers and working on class assignments. Despite recess and sports, on average, over a seven-day consecutive span, children between the ages of 6-11 spend six of their waking hours per day in sedentary behavior (Matthews et al., 2008). Moreover, children between the ages 8–18, spend approximately 7.5 hours in front of the screen each day using entertainment media. This includes 4.5 hours of TV, approximately 1.5 hours on the computer, and over an hour playing video games. Furthermore, due to a tendency to use two mediums at once, children are actually condensing approximately 10 hours and 45 minutes of media content into that 7.5 hours of time. When compared to five years ago, this is an increase of almost 2.25 hours of media exposure per day (Rideout, Foehr, & Roberts, 2010).

All of this sitting takes its toll on the body. Physically, children's backs are not as healthy due to the consequences of stationery idleness. According to Bejia et al. (2005), low back pain in children was considered rare for many years, yet in the last two decades nonspecific back pain in children grew to higher levels than in previous years. After studying 622 children, dissatisfaction with a school chair was named as one of the main factors attributing to low back pain (Bejia et al., 2005).

Moreover, in another study involving female college students sitting on therapy balls, researchers found a significant improvement in sitting comfort, particularly in the neck region (Al-Eisa, Buragadda & Melam, 2013). Besides the positive physical impact to students' skeletal support systems, researchers have noticed secondary benefits as well, mainly in the area of attention (Illi, 1994).

In Switzerland, Illi (1994) realized how harmful sitting at a desk for lengthy periods of time could be. Identifying the need to get children moving, Illi (1994) studied the alternative use of therapy balls in the classroom in lieu of classroom chairs. A therapy ball is a large, round inflatable ball, sometimes referred to as an exercise ball or stability ball. Historically, therapy balls have long been promoted by occupational therapists for exercising and stretching. In Illi's (1994) prominent study, the notion of postural benefits due to active sitting was introduced. Illi (1994) found that children's backs improved due to the movement and core strengthening factors promoted by sitting on a therapy ball. Moreover, Illi (1994) found that attention increased and hyperactivity decreased.

Executive functioning: attention and hyperactivity-impulsivity. In an effort to evaluate the link between movement and attention, Fedewa and Erwin (2011) studied 76 students in the fourth and fifth grades to find out if sitting on therapy balls instead of chairs made a difference regarding attention. This research was evaluated by measuring in-seat and on-task behavior. All 76 children made improvements, especially those children who had lower executive functioning levels. For eight of the children who normally struggled to pay attention, either those who were diagnosed with attention deficit hyperactivity disorder (ADHD) or who were not formally diagnosed but showed ADHD symptoms, in-seat and classroom behavior improved substantially. Before the implementation of the stability balls, these children spent an average of 10% of their time on-task. After the intervention of the stability balls, these children spent 80% of their time on task. Additionally, pre-intervention, the children spent 45% of their time in their seats. Post-intervention, they spent 94% of their time in their seats. Furthermore, even though not statistically significant, all 76 children represented in the general classroom improved overall in their executive functioning, namely decreasing symptoms of hyperactivity, impulsivity, and inattentiveness (Fedewa & Erwin, 2011).

Other research which focused exclusively on children exhibiting ADHD symptoms found similar results. In an A-B-A-B interrupted time series design, in-seat behavior improved when seated on therapy balls versus normal classroom chairs (Schilling, Washington, Billingsley, & Deitz, 2003). Likewise, children on the autism spectrum showed positive results. Researchers found substantial improvements in engagement and in-seat behavior when subjects used therapy balls in the classroom in place of chairs (Bagatell et al., 2010; Schilling & Schwartz, 2004); however, for those children with autism spectrum disorder (ASD) who had poor postural stability, the therapy balls were not effective (Bagatell et al., 2010).

Executive functioning: working memory and processing speed. According to the above research, using a therapy ball can help in behavioral situations within the classroom, but how does movement directly affect performance outcomes? Erickson et al. (2011) and Medina (2008) posit that exercise improves cognition, especially in the areas of learning and memory. Movement is essential to activating mental capacities. Information and experiences are anchored and integrated more thoroughly into the neural network through movement (Erickson et al., 2011; Hannaford, 2005).

This finding is evidenced in recent studies on how movement affects working memory and processing speed. Although the available research used limited sample sizes, Kercood and Banda (2012) identified four elementary children as subjects in a general education setting: two of these children were typical students, not formally diagnosed with a learning disability or other condition. Of the remaining two students, one child was formally diagnosed with an attention disorder and the other had a learning disability. Kercood and Banda (2012) tested the children's ability to answer multiple choice test questions after listening to a story on an audio recorder. They tracked the number of correct answers and the amount of time needed to complete the test. These tests were conducted in three different scenarios: first, the students took the tests in a baseline condition, sitting on normal classroom chairs. In the next condition, the students sat on chairs but were also allowed to doodle. Finally, in the last condition, the students sat on therapy balls. In both the doodling and therapy ball scenarios, all four students improved in test accuracy and time of completion; they had more correct answers and took less time to answer the questions (Kercood & Banda, 2012).

In another study with a limited number of participants, positive performance outcomes when sitting on therapy balls were manifested as well. Schilling et al., (2003) analyzed three children who had attentional deficits to find out if legible word productivity improved when sitting on therapy balls. They analyzed the children's handwriting by calculating the difference between the children's handwriting during a baseline condition (no therapy balls) and an intervention condition (using therapy balls). Even though only three children were being studied, the entire class of students was using therapy balls. The results indicated that all three participants who had attentional deficits improved in legible word productivity when seated on the therapy balls (Schilling et al., 2003).

In another study comparing 15 children diagnosed with ADHD to 14 typically developing children, Wu et al. (2012) found increases in reaction time for those children diagnosed with ADHD when sitting on therapy balls. In the experiment, the subjects were in a non-classroom environment. They were asked to listen to auditory tones and press a button after hearing a high tone, and do nothing after hearing a low-frequency tone. The children were tested while sitting on chairs, and then while sitting on therapy balls. Results showed that the ADHD diagnosed children had slower reaction time than the control group when sitting on chairs. When the reaction time of the ADHD diagnosed children was measured while sitting on the therapy balls, however, they showed significant improvement (Wu et al., 2012). The reaction time of the control group did not significantly improve when those children sat on the therapy balls. This result shows that using therapy balls for children diagnosed with ADHD improves reaction time, ultimately decreasing the difference between children with ADHD and those without (Wu et al., 2012).

Masters thesis and unpublished research. Due to the scant amount of peer-reviewed research which examines the relationship between therapy balls and executive functioning and behavior, the following studies will be reviewed to add to the current peer-reviewed literature. Bill (2008) researched 12 high school students in a special education classroom using therapy balls for 12 weeks. Using an A-B-A-B study design, Bill's (2008) findings revealed an increase in students' on-task behavior, plus an achievement increase in fluency, comprehension, addition fact scores, subtraction fact scores, and math probe scores. Furthermore, the students reported a preference for the therapy balls (Bill, 2008).

In another unpublished study, four students in the second grade and four students in the fifth grade were researched using therapy balls (Gamache-Hulsmans, 2007). Of the eight students, one child in each grade had ADHD symptoms.

Overall, the second graders had a 19.6% average improvement rate in terms of on-task behavior when using therapy balls. In contrast, students in grade 5 did not improve, except for one child who had ADHD symptoms. These same students were also evaluated in terms of legible handwriting. During pre- and post-testing, they were assessed on number of words written during a 10-minute interval, and quality of their work. The second grade class together improved an average of 33%; the student with ADHD symptoms improved 78% in quantity. For quality, the second graders improved an average of 7%; the student with ADHD symptoms improved 34%. It should be noted, however, that the child with ADHD symptoms may have improved due to the implementation of medication during post-testing. The fifth grade class had an improvement by 6% in quality; the student with ADHD symptoms was medicated pre- and post-testing and improved by11% (Gamache-Hulsmans, 2007).

Self-Esteem. Besides executive functioning issues being related to some learning disorders, research has shown that low self-esteem can also be associated with learning and behavioral problems (Dole & Mc Mahan, 2005; Martínez & Semrud-Clikeman, 2004) and symptoms of hyperactivity in children (Frankel et al., 1999). In their study, Frankel et al. (1999) provided an intervention using stimulants with children diagnosed with ADHD. When the behavior of the hyperactive children was improved through the use of stimulants, the children's self-esteem also improved significantly (Frankel et al., 1999). The children with ADHD reported feeling more intelligent, more popular, and better behaved (Frankel et al., 1999). Another study on disruptive elementary children in the classroom found similar results. Upon completion of a cognitive-behavioral intervention, self-esteem and perceived self-control significantly improved (Larkin & Thyer, 1999).

This finding is counterintuitive to what researchers have thought in the past. For years there has been a movement to increase children's self-esteem through bolstering how a child *feels* rather than applauding children for what they *do* (Seligman, 2007). Self-esteem was viewed as being the predictor of successful components such as academic achievement. Yet, in spite of this self-esteem campaign, children were becoming increasingly depressed (Seligman, 2007).

Recent research suggests that there are no correlations (Ross & Broh, 2000) or only modest correlations between self-esteem and academic performance. Instead, good school performance is posited as the predictor of enhanced self-esteem (Baumeister, Campbell, Krueger, & Vohs, 2003). In essence, building children's self-esteem through false hope or compliments will not be effective. Rather than focus on boosting children's self-esteem, it may be more fruitful to focus on improving behavior and executive functioning, which in turn, could lead to strengthened self-esteem. Since prior research showed that therapy balls in the classroom improved attention, hyperactivity, and performance, it is conceivable that therapy balls in the classroom may also positively affect children's self-esteem.

Gender. For years, classroom disruptions, learning disorders, and behavioral problems have been linked to boys more than girls. For example, boys are more than twice as likely to be diagnosed with ADHD as girls, and 2/3 of students diagnosed with learning disorders are male (Adams, 2007; Cortiella & Horowitz, 2014). According to Biederman, Faraone, and Monuteaux (2002), boys are more vulnerable to ADHD than girls. Autism is also an area that shows a higher rate of diagnosis in boys than girls; it is diagnosed four times more in males than females (APA, 2013; Bartley, 2006).

Besides research showing that learning disorders are more prevalent in boys, there also may be biased opinions by teachers and parents involving gender. One study by Ohan (2009) addressed why girls were less likely than boys to be referred for mental health services for ADHD. When 96 parents and 140 teachers read various vignettes about equal numbers of boys and girls with ADHD, parents and teachers were more likely to seek or recommend services for boys than girls. Results revealed that parents and teachers believed that learning assistance was more effective for boys with ADHD than girls (Ohan, 2009). This belief could be partly due to ADHD in girls being underdiagnosed (Gaub & Carlson, 1997; Quinn, 2005). ADHD in girls is not always recognized because the symptoms are less overt, and are often hidden (Gaub & Carlson, 1997; Quinn, 2005). Given that boys have traditionally been plagued more by disorders related to executive functioning (Hannaford, 2005) and are thought to be more amendable to interventions for some learning disorders (Ohan, 2009), it is plausible that males will improve more than females when using therapy balls in the classroom.

Rationale/Purpose of the Study/Significance of the Study

As aforementioned, children's executive functioning mechanisms can improve due to implementing therapy balls in the classroom (Illi, 1994; Schilling et al., 2003). The freedom to move kinesthetically coupled with the physical exertion needed to maintain balance on a therapy ball can positively affect attention, hyperactivity (Illi, 1994; Schilling et al., 2003), and academic performance based on comprehensive listening skills (Kercood & Banda, 2012), and on more legible handwriting (Fedewa & Erwin, 2011). Poor handwriting has been observed by teachers and clinicians to negatively impact academic performance and self-esteem (Racine, Majnemer, Shevell, & Snider, 2008).

Yet, despite the acknowledgement of the benefits of using therapy balls in the classroom, much of the current research has been anecdotal or was conducted using a limited number of subjects, such as four or eight students. Additionally, the majority of studies were conducted on students who struggled with ADHD and autism spectrum disorder (ASD), focusing mainly on attention and in-seat behavior. Furthermore, there has been little research on a particular age-group of children: children in the first grade. This is a pivotal year for future academic success due to the acquisition of reading skills (Lane, O'Shaughnessy, Lambros, Gresham, & Beebe-Frankenberger, 2001). Additionally, research has shown that preventative interventions done in first grade can positively impact educational outcomes in high school and beyond (Alexander et al., 1993; Bradshaw et al., 2009; Entwisle et al., 2005).

In the present study, the research base was extended by focusing on a sample size that was larger than most of the current research, was inclusive of all children in the classroom, and specifically focused on children in the first grade. Furthermore, since some executive functioning deficits may lead to a decline in self-esteem, the impact of therapy balls on children's self-esteem was addressed as well. Finally, since the majority of children with learning disorders, such as ADHD are boys (Cortiella & Horowitz, 2014), the present study was used to examine whether boys improved more than girls.

Using the therapy ball as an independent variable, the following dependent variables were analyzed: attention, hyperactivity-impulsivity, working memory, processing speed, self-esteem, and gender differences. The hypotheses for this study related specifically to these constructs.

Research Questions/Hypotheses

Due to increasing learning and neurodevelopmental disorders in children, it is possible that educators need to adapt and make changes to the classroom environment in order to meet the needs of these children. Since using therapy balls in the classroom instead of chairs has already displayed some positive results in children's behavior and learning, it would be beneficial to validate and extend the research on this topic.

The hypotheses for this study were directional, predicting the following:

1. Students' attention will increase when sitting on therapy balls compared to when sitting on chairs.
2. Students' hyperactivity-impulsivity will decrease when sitting on therapy balls compared to when sitting on chairs.
3. Students' working memory will increase when sitting on therapy balls compared to when sitting on chairs.
4. Students' processing speed will increase when sitting on therapy balls compared to when sitting on chairs.
5. Students' self-esteem will increase when sitting on therapy balls compared to when sitting on chairs.
6. Boys will be affected more positively than girls when sitting on therapy balls compared to when sitting on chairs.

Chapter 2

An experimental, within-subject design was implemented using pre- and post-testing assessments.

Participants

The research was conducted at a private school located in a suburban area in the northwest part of Washington. The participants consisted of a convenience sample of 44 first-graders split between three classrooms with three teachers. Of the 44 students, 24 were boys and 20 were girls.

Materials

Six assessments were used: the Behavioral Rating Inventory of Executive Functioning (BRIEF) scale, two subscales of the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV), the Culture Free Self-Esteem Inventory – Third Edition (CFSEI-3), a simple questionnaire regarding students' peer relations, and a student and teacher questionnaire regarding preference of chairs versus therapy balls.

Behavioral Rating Inventory of Executive Function (BRIEF). The BRIEF scale was used to assess attention and hyperactivity-impulsivity. Attention is defined as cognitive processes, allowing a person to concentrate on certain stimuli, while ignoring others. Attention is responsible for controlling one's mental environment by selecting the stimuli that enter one's consciousness (Revlin, 2013). Hyperactivity, according to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM–5; American Psychiatric Association [APA], 2013), refers to excessive fidgeting, tapping, or talkativeness; whereas impulsivity refers to hasty actions or decisions that occur in the moment without forethought. Also, impulsivity may manifest itself as social intrusiveness, immediate reward seeking behavior, and lacking ability to delay gratification. Since the DSM-5 uses the terms hyperactivity and impulsivity together to specify the type of ADHD a child may have—ADHD, hyperactive-impulsive type (APA, 2013), these terms were combined in this dissertation.

The BRIEF was designed for children between the ages of 5-18 and takes 10-15 minutes to complete (Gioia, 2000). It has 86 questions and uses a 3-point scale (Never, Sometimes, Often). There are parent and teacher forms (Gioia, 2000), but for the purposes of this study, only the teacher form was used. The parent form was not useful given that the therapy balls were only used in the school setting. The BRIEF is comprised of eight subdomains of executive functioning: Inhibit, Shift, and Emotional Control scales make up the Behavioral Rating Index (BRI) while the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor make up the Metacognition Index (MI). The BRI and MI can be combined to have an overall Global Executive Composite (GEC). Additionally, there are two validity scales (inconsistency and negativity). The Working Memory and Inhibit scales differentiate between ADHD subtypes. The Working Memory scale is useful in diagnosing ADHD, predominantly inattentive type, whereas the Inhibit scale is useful in diagnosing ADHD, predominantly hyperactive-impulsive type (Gioia, Isquith, Guy, & Kenworthy, 2000).

The normative data is based on child ratings from 1,419 parents and 720 teachers from rural, suburban, and urban areas. The Cronbach, a coefficient measure of internal consistency, ranged from .80-.98 for the parent and teacher forms for clinical and normative samples. The BRIEF also displays high test-retest reliability with a subsample correlation of r =.87 (range: .83-.92), and BRI, MCI, GEC retest correlations are .92, .90,

.91 respectively. Additionally, test-retest T score differences show T score stability over a two to three week interval, supporting use of the BRIEF for repeat administration (Gioia et al., 2000).

Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV). The WISC-IV was developed for use with children between the age of 6 and 16. It is designed to be administered individually (Assouline, Nicpon, & Dockery, 2012). The WISC-IV contains 10 subtests which can be used independently or combined to give a full scale intelligent quotient (FSIQ). The subtests vary in administration; some scales require the subject to manipulate data while other scales involve questions. The administrator asks the questions and documents the subject's answers verbatim. The number of questions will vary for each participant, since the subtests are designed to allow the participant to continue through the test if the answers are correct. If, however, the participant begins answering incorrectly, after a predetermined number of incorrect answers the test is stopped. For the purposes of this study, only the indices Working Memory and Processing Speed were used. Working memory is the set of mechanisms that underlies short-term memory and connects with long-term memory. Working memory capacity is synonymous with executive attention (Engle, 2002). It is a semi-permanent storage for memory that assists in learning new information (Revlin, 2013).

The Working Memory index of the WISC-IV is comprised of the subscales: Digit Span (DS) and Letter Number Sequencing (LN). Digit Span (DS) is a measure of rote and manipulative memory, whereas, Letter Number Sequencing (LN) measures short-term and manipulative memory (Assouline et al., 2012). Arithmetic (AR) is an optional subscale in the Working Memory index and can be substituted for DS or LN, or used for retest purposes (Wechsler, 2004). Since the researcher used the WISC-IV for pre- and post-testing, it was necessary to consider potential practice effects. In the Working Memory index, practice effects or test-retest gains are negligible (Wechsler, 2004).

Processing speed can be explained by its similarity to the operating speed of the central processing unit of a computer. Speed of processing can be measured via a visual or auditory task (Breznitz & Meyler, 2003) and is associated with performance of higher-order cognition (Kail & Salthouse, 1994). Learning, comprehension, and mental fatigue can all be affected by slow processing speed. Furthermore, many daily activities which demand completion of tasks in a timely manner can be compromised by slow processing speed (Hedvall et al., 2013).

The Processing Speed index of the WISC-IV is comprised of the subscales: Coding (CD) and Symbol Search (SS). Coding (CD) is a measure of fine motor skills and visual processing; Symbol Search (SS) evaluates cognitive processing and visual scanning. These are both used to test for perceptual discrimination, visual acuity, and speed of mental processing (Assouline et al., 2012). Cancellation (CA) is an optional subscale in the Processing Speed index and can be substituted for CD or SS, or used for retest purposes (Wechsler, 2004). Cancellation (CA) measures processing, visual selective attention, vigilance, and visual neglect; it has negligible practice effects (Wechsler, 2004). Of the three subtests, at least two must be used in order to get a composite Processing Speed index (Wechsler, 2004). Since there is more opportunity for incurring practice effects on CD and SS of the Processing Speed Index, all three subscales—CD, SS, and CA—were administered for Processing Speed.

The reliability coefficients for the composite scales are as follows: .88 (AR), .85 (DS), .90 (LN) for working memory and .85 (CD), .79 (SS), and .79 (CA) for processing speed. Validity measures are reported as high and are based on examining the relationship between the WISC-IV and other measures such as the Children's Memory Scale and the Behavioral Assessment System (Williams, Weiss, & Rolfhus, 2003). Specifically, convergent validity correlations between the WISC-IV and the Wechsler Intelligence Scale for Children III (WISC-III) is .81 for Processing Speed index and .72 for Working Memory index (Niolon, 2005). Convergent validity correlations between the WISC-IV and the Wechsler Adult Intelligence Scales (WAIS-III) are .77 for Processing Speed index and .79 for Working Memory index (Niolon, 2005).

Culture Free Self-Esteem Inventories - Third Edition (CFSEI-3). The Culture Free Self-Esteem Inventory- Third Edition (CFSEI-3) was developed by Battle (2002) to assess self-esteem. Self-esteem can be defined using a global approach: the person's attitude—either positive or negative—toward the self in totality (Rosenberg, Schooler, Schoenbach, & Rosenberg, 1995). The CFSEI-3 is norm-referenced and intended to draw out perceptions of personal traits and characteristics in children aged 6 through 18 years. The instrument is used as a self-report inventory and has simple yes-no answers. It can be read aloud or taken in written form. If taken in written form, it is appropriate for any child who is able to read at the third grade level (Ntshangase, Mdikana & Cronk, 2008). Since some of the children in this study were not at a third grade reading level, the researcher read it aloud to all of the children. Additionally, it can be given to students in a group format (Battle, 2000) and takes between 15-20 minutes to administer. The CFSEI-3 will yield a total score, the Global Self-Esteem Quotient (GSEQ), which embodies overall performance (Ntshangase et al., 2008). Reliability of the CFSEI-3 was examined using estimates of content sampling and time sampling. For GSEQ scores, average internal consistency coefficients ranged from .81 to .93 and time sampling coefficients ranged from .72 to .98 (Battle, 2002). Additionally, the CFSEI-3 has been broadly used in South Africa, proving to be reliable for use in a multi-cultural context (Battle, 2002).

Questionnaires. Three simple questionnaires were used. The first questionnaire used a 5-point Likert scale format, and addressed each child's behavior and performance relating to peer relations, reading, math, and written language skills. The second and third questionnaires asked the teachers and children, respectfully, whether they preferred chairs or therapy balls.

Procedures

After parental consent was obtained, each child was fitted for a therapy ball. In order to maintain safety and postural health, the balls were customized to each student, ensuring the proper positioning. Proper positioning necessitated having the child sit comfortably, both feet flat on the floor, with knees and hips flexed at 90 degrees. The therapy balls used for this study had molded feet that extended when the ball was not in use to prevent the ball from rolling away. The therapy balls were called Fitpro, designed by Champion Sports.

During the baseline procedure, each of the three teachers used the BRIEF as a pretest to assess the children, establishing a baseline condition before using the therapy balls. The teachers also filled out the behavior and performance questionnaire. The teachers completed these assessments in the week before the therapy balls were brought into the classroom. Their answers were based on the students' behavior for the four-week period on chairs, before sitting on the therapy balls.

Additionally, the children were assessed in the week before the therapy balls were brought in for a baseline condition using the WISC-IV. They were also assessed using the CFSEI-3. These assessments were completed while the children were sitting on their normal classroom chairs.

In the 3-week therapy ball stage, the children sat on their therapy balls in lieu of chairs. This took place during all normal times in which they needed to be at their desks. Recess, lunch, and unique subjects such as art or science lab did not necessitate sitting on the therapy balls.

The first two days of using the therapy balls required training and rule-setting to insure proper techniques while sitting on the balls. Additionally, this period was used to eliminate the novelty effect of the balls. The classes spent 15-20 minutes discussing the rules which were outlined as follows: (1) both feet on the floor at all times, (2) no sharp objects around the balls, (3) silliness such as throwing, kicking, or hand-bouncing the balls was not allowed, (4) extreme bouncing while sitting was not allowed (5) when moving normally, feet must be on the floor and bottoms must be on the ball, (6) children were given one warning before the ball was removed. If the rules were not followed, the student would lose the privilege of using the ball until the next class period. In order to track this potentially disruptive behavior, the teachers wrote down notes at the end of the day addressing any challenges that arose and why they happened. Since the main purpose of the study's 3-week time duration was to normalize the use of therapy balls in the classroom and reduce potential novelty effects, it was not mandatory that all of the children utilize the balls 100% of the time. If, for instance, disruptive behavior caused a child to lose ball privileges for an hour one day, this probably would not impact the research. The consecutive amount of time on the ball was not the focus since any fluctuation in behavior would be happening in the "here and now."

During the last two days of the therapy ball stage, the children were reassessed using the WISC-IV and the CFSEI-3 to establish a therapy ball measure. These assessments were employed while the children were sitting on the therapy balls. Additionally, the teachers completed the BRIEF and the behavior and performance questionnaire as a post-test to reassess the children. Finally, the teachers and students were given the simple questionnaires addressing their preference for the chairs or therapy balls.

Summary

This study was implemented by examining the impact of therapy balls on children's executive functioning and self-esteem in three different classrooms, consisting of 44 first grade children. The constructs of attention, hyperactivity-impulsivity, working memory, processing speed, self-esteem and gender were analyzed using pre- and post-testing measures. The assessments employed were: the BRIEF, the WISC-IV, the CFSEI-3, and three simple questionnaires. The children were assessed on two separate occasions. The first assessment occurred before the therapy balls were introduced to the classroom and the children were assessed while sitting on chairs. The second assessment occurred after the balls had been in the classrooms (replacing the chairs) for three weeks. The children were assessed while sitting on the balls for the second assessment.

Chapter 3

Results

A series of two-way ANOVAs were conducted to examine the relationship between therapy ball usage and a variety of cognitive and emotional variables. Data was used from the two times when the children were assessed: one time when they sat on chairs and one time when they sat on therapy balls. There were 27 different analyses which were conducted using SPSS. These analyses are discussed as they relate to each hypothesis construct: attention, hyperactivity-impulsivity, working memory, processing speed, and self-esteem. When conducting the series of 2x2 ANOVAs, the second variable was always gender. The hypothesis regarding gender differences was not significant for any of the constructs and there were no significant gender interactions. Therefore, the hypothesis predicting that boys would improve with the implementation of therapy balls more than girls was not supported as it related to any of the constructs and will not be repeatedly reported in the subsequent sections.

Finally, the results from the teacher and student questionnaires (Appendices B and C) regarding preference of chairs versus therapy balls will be reported.

Attention. The first hypothesis predicted that attention would increase with the use of therapy balls. This was tested by having the teachers fill out the Working Memory subscale of the Behavior Rating Inventory of Executive Function (BRIEF) assessment. On the BRIEF scales, higher ratings equate to poorer executive functioning. Since there were three classes with three teachers, an analysis of class differences was conducted first. When computing the statistics, one teacher's ratings were significantly different from the others. Using a one-way between subjects ANOVA, a main effect of BRIEF rating difference between the three classes—delineated as class A, B, and C—was discovered F (2, 41)=13.12, *MSe*= 606.70 $p < .05$, r =.44 such that class C teacher ratings (*M*=132.13, *SD* = 38.19) were significantly different from class A (*M*=90.14, *SD*=12.38) and class B (*M*=94.00, *SD*=13.26). The teacher whose rating scores were significantly different also scored high in the negativity scale. When the negativity scale is high, it is possible that the respondent had an unusually negative response style which can skew the results (Gioia et al., 2000). For these reasons, class C results were not included in any of the analyses of the BRIEF scales.

After deleting teacher C's results, a two-way within subjects ANOVA was used to examine how the use of therapy balls affected students' attention on the Working Memory subscale of the BRIEF. A main effect of therapy ball usage was not discovered F (1, 27)=.18, *ns,* n^2 = .01.

Hyperactivity-Impulsivity. The second hypothesis predicted that hyperactivity-impulsivity would be reduced with the use of therapy balls. This hypothesis was examined by having the teachers fill out the inhibit subscale of the BRIEF assessment. By using a two-way within subjects ANOVA, a main effect of therapy ball usage was discovered F (1, 27)=4.87, p <.05, n^2 = .15 such that when children used therapy balls (*M*=46.58, *SE*=1.22), they were significantly less hyperactive and impulsive than when sitting on chairs (*M*=48.58, *SE*=1.42).

Working memory. The third hypothesis predicted that working memory would improve with the use of therapy balls. This hypothesis was tested by assessing the children on two subscales of the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV). Using a two-way within subjects ANOVA, analyses of the Letter

Number Sequencing subscale, the Digit Span subscale, and the combined Working Memory index were conducted. On the Letter Number Sequencing subscale, a main effect of therapy ball usage was discovered F (1, 42)=23.60, p <.05, n^2 = .36 such that when children used therapy balls (*M*=12.70, *SE*=.43), they performed significantly better than when sitting on chairs (*M*=11.05, *SE*=.49). On the Digit Span subscale, a main effect of therapy ball usage was not discovered F (1, 42)=3.30, *ns*, n^2 = .07. Finally, on the total Working Memory scale, a main effect of therapy ball usage was discovered F (1, 42)=31.21, p <.05, n^2 = .43 such that when children used therapy balls (*M*=24.70, *SE*=.68), they performed significantly better than when sitting on chairs (*M*=22.63, *SE*=.71).

Processing speed. The fourth hypothesis predicted that processing speed would improve with the use of therapy balls. This was tested by assessing the children on three subscales of the WISC-IV using a two-way within subjects ANOVA. The three subscales were: Coding, Symbol Search, and Cancellation.

For Coding, a main effect of therapy ball usage was discovered F (1, 42)=52.52, p <.05, n^2 = .56 such that when children used therapy balls (*M*=12.93, *SE*=.42), they performed significantly better than when sitting on chairs (*M*=11.00, *SE*=.39). For Symbol Search, a main effect of therapy ball usage was discovered F (1, 42)=70.66, p <.05, n^2 = .63 such that when children used therapy balls (*M*=14.62, *SE*=.35), they performed significantly better than when sitting on chairs (*M*=12.55, *SE*=.33). Then, on the Cancellation subscale, a main effect of therapy ball usage was discovered F (1,42)=22.08, p <.05, n^2 = .35 such that when children used therapy balls (*M*=13.00, *SE*=.38), they performed significantly better than when sitting on chairs (*M*=11.73, *SE*=.36).

Self-Esteem. The fifth hypothesis predicted that children's self-esteem would increase with the use of therapy balls. This was tested by using the Culture Free Self-Esteem Inventories - Third Edition (CFSEI-3). The CFSEI-3 is a self-report assessment for the children. One child had extreme outlier scores and was not old enough to qualify for the age range recommended for the CFSEI-3; therefore, her scores were not used. Additionally, there were six students whose scores had to be deleted due to not fully completing the assessment.

The effect of therapy balls on students' self-esteem was examined by using a two-way within subjects ANOVA. A main effect of therapy ball usage was discovered F (1, 35)=11.13, p <.05, n^2 = .24 such that when children used therapy balls (*M*=96.40, *SE*=1.38), they had significantly higher self-esteem than when sitting on chairs (*M*=92.90, *SE*=1.54).

Other executive function construct from the BRIEF. Determining how the use of therapy balls affected students' ability to monitor themselves was analyzed on the Monitor subscale by using a two-way within subjects ANOVA. A main effect of therapy ball usage was discovered F (1, 27)=9.79, p <.05, n^2 = .27 such that when children used therapy balls (*M*=43.87, *SE*=1.23), they performed significantly better in monitoring ability than when sitting on chairs (*M*=46.56, *SE*=1.50).

Questionnaire 2. After the experiment was finished, each of the three teachers was surveyed. The questionnaire asked whether they preferred students sitting on chairs or therapy balls. All of the teachers (100%) preferred that the students sit on chairs.

Questionnaire 3. After the experiment was finished, each of the 44 children was also surveyed on whether they preferred sitting on chairs or therapy balls. Of the 44 children, 38 students (86%) preferred sitting on the therapy balls. Using a two-way within subjects ANOVA, a main effect was discovered F (1, 42)=268.26, $p< .05$, $n^2=.87$ such that there was a significant preference for therapy balls (M=1.86, SE= .05) over chairs (M=1.00, SE=.00).

Chapter 4

Discussion

The purpose of this study was to assess executive functioning in students using therapy balls in the classroom in lieu of chairs. The children were assessed on two separate occasions in order to compare data: once when they sat on chairs and once when they sat on therapy balls. The overall research findings are promising in that children significantly improved when using therapy balls in several important areas of executive functioning, yet significance was not found in each hypotheses. Attention did not improve significantly with the use of therapy balls, and even though it was improving in the predicted direction, the first hypothesis was not upheld. In contrast to this finding, working memory, hyperactivity-impulsivity, and processing speed improved significantly when children used therapy balls. These findings upheld hypotheses two, three, and four. This translated into students' enhanced learning and performance in the classroom which aided in increasing children's self-esteem when using therapy balls; therefore, hypothesis five was upheld. In analyzing gender differences, hypothesis six, significance was not found which may be inconclusive due to the population lacking a substantial number of children with executive functioning challenges.

Executive functioning.

Attention, working memory, and hyperactivity-impulsivity. According to the results of this study, typical and atypical children performed significantly better in several areas when using therapy balls. Despite this finding, the first hypothesis predicting that children's attention would improve with therapy balls was not upheld. This was evidenced by teacher ratings on the Behavior Rating Inventory of Executive Function

(BRIEF) Working Memory subscale, the assessment employed for this hypothesis. In this study, teachers did not observe significantly improved attention. This finding contradicts research done by Al-Eisa et al. (2013) and Illi (1994) who found increased attention with therapy ball use. Schilling et al. (2003) also found improvement in attention via increased legible word productivity with children who had ADHD when on therapy balls. Additionally, Schilling and Schwarz (2004) found substantial improvement in engagement when studying children with autism spectrum disorder (ASD) on therapy balls. Furthermore, in Gamache-Hulsman's (2007) master's thesis, children who had ADHD symptoms, or were younger in age, improved in on-task behavior, yet older children did not. It should be noted, however, that even though the present research was not significant in attention, it was in the predicted direction. The teachers rated the children's attention as improving slightly with the implementation of therapy balls on the BRIEF Working Memory subscale.

Due to the inconsistencies in the research findings, it is possible that human bias or differences in measurements and sampling techniques influenced the research studies. In some of the other studies, the researchers were rating the children, whereas in the present study, attention was measured by the teachers' observations, not the researchers' observations. Additionally, some of these studies only used populations of children with attentional deficits or younger children. These studies are not necessarily generalizable to larger populations.

The second hypothesis predicting that working memory would increase was upheld. This aligns with research by Kercood and Banda (2012) who found that therapy ball use improved students' auditory listening skills as measured by test accuracy. This finding may be due to the theory that physical movement increases brain engagement (Hannaford, 2005). Sitting in one position for a long period of time can lead to decreased stimulation. When the body does not move, there may be decreased proprioceptive and kinesthetic feedback, resulting in decreased attention and under arousal (Lange, 2000). According to Erickson et al. (2011) and Hannaford (2005), movement is integral to activating mental capacities. Information and experiences are secured and assimilated more thoroughly into the neural network through movement (Erickson et al., 2011; Hannaford, 2005).

The third hypothesis predicting that hyperactivity-impulsivity would decrease was also upheld. This finding aligns with research by and Schilling and Schwartz (2004) who found children with ADHD had improved in-seat behavior when on therapy balls. Furthermore, researchers Fedewa and Erwin (2011) and Illi (1994) found decreased hyperactivity-impulsivity when children used therapy balls. In contrast, however, to the present study's results showing typical and atypical children significantly improving in attention and hyperactivity-impulsivity, Fedewa and Erwin (2011) only found significance with the eight children in their study who were either diagnosed with ADHD or had elevated levels of attentional concerns. In their total study of 76 children, the 68 typically developing children also improved in hyperactivity-impulsivity, but not enough to be claimed as significant. It is plausible that children with executive functioning deficits such as ADHD would improve in hyperactivity-impulsivity since therapy balls give children a chance to fidget and wiggle while still maintaining composure in class. Yet the current research showed that typically developing children also improved. This result could be due to the age of children that were researched. Younger children generally have more difficulty controlling their impulses, partially due to their prefrontal cortexes, the part of the brain which controls impulses and decision-making processes, not being as fully developed as in an older child (Diamond, 2002).

Processing speed. The fourth hypothesis predicting increased processing speed with therapy ball use was upheld. This was evidenced by the significantly higher scores and overall strong effect size on the WISC-IV processing speed subscales. This result corresponds to the research done by Kercood and Banda (2012) who found that students took less time to perform tasks when using therapy balls. Additionally, Wu et al. (2012) found that the use of therapy balls increased processing speed for certain children. In their study, children diagnosed with ADHD had slower reaction times than typically developing children when sitting on chairs. Yet, when the children diagnosed with ADHD sat on therapy balls, their reaction time improved significantly, bringing their scores in line with typically developing children's scores which were attained while sitting on chairs. In contrast to the present study's results showing typical and atypical children significantly improving in processing speed, Wu et al. (2012) found that only children with ADHD significantly improved in reaction time when using therapy balls. Their study showed that typically developing children's reaction time did not improve significantly; the children's performance was similar whether sitting on chairs or therapy balls. The discrepancy between this study's finding and the study by Wu et al. (2012) could be due to how processing speed was measured. Wu et al. (2012) measured reaction time to an auditory signal, whereas this study measured processing speed via a visual component by identifying codes and symbols and writing them onto paper. Research suggests that proprioceptive feedback is involved in hand and arm movement (Pipereit, Bock, & Vercher, 2006; van Beers, Sittig, & van Der Gon, 1999). Since movement on therapy balls is a form of proprioceptive feedback, this may partially explain why Schilling et al. (2003) found increased legible handwriting when students used therapy balls. It is also possible that the present study, which measured visual processing speed via a writing component, enabled significant improvement with entire classes of children. It is plausible that therapy balls improve both typical and atypical children's visual processing speed due to the connection between proprioceptive feedback and hand movement, but significantly improve only the auditory processing speed of children with attentional deficits. Furthermore, the research sample used by Wu et al. (2012) only consisted of 14 children who did not have attentional deficits. A larger sample may have revealed different results.

Due to the large effect size represented in the processing speed results of this study, a question regarding potential practice effects could emerge. Practice effects have been noted on some areas of the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV), but the practice effects for both the Coding and Cancellation subscales for 6-7 year-olds were negligible (Wechsler, 2004). Additionally, the practice effect on the Symbol Search subscale was small (Wechsler, 2004). Other research studies have used the WISC-IV for pre- and post-testing with no adjustment for potential practice effects (Gordon, 2009; Mackey, Hill, Stone, & Bunge, 2011). Moreover, since the overall processing speed effect size was large, it provides ample support for the results of the present study.

Other subscales. There were several other subscales of the BRIEF that corresponded to executive functioning behavior, but were not intended to support or negate specific hypotheses of the present study. Out of these remaining subscales, only the Monitor subscale showed significant improvement in performance when students were on the therapy balls. The Monitoring subscale measures whether children can assess their performance on tasks to ensure the suitable fulfilment of a goal (Gioia, Isquith, Guy, & Kenworthy, 2000). For example, is the child's work self-checked before turning it into the teacher? Additionally, the Monitoring subscale measures the ability for children to keep track of how their behaviors affects others (Gioia et al., 2000). This result of increased monitoring may be due to the possibility that children were more content on the therapy balls. The Optimal Stimulation theory originally suggested by Hebbs (1955) and Leuba (1955) posits that all living organisms have varying desires for stimulation and movement. Therapy balls allow children to move a lot, or a little, depending on their individual needs. This flexibility in movement may help them reach a place of homeostasis, enabling an optimal environment for learning. Therapy balls offer students a vehicle for self-modulation of individual sensory needs (Schilling et al., 2003).

The challenges with self-modulation may be further compounded by the environment that many modern children are raised in. Their brains are used to adapting to lights, sounds, and continual stimuli from TV, computers and smart phones. Hannaford (2005) believes that when children are entertained by TV, they are orienting to a pattern that decreases physical, emotional, and sensory connection. TV may make the child feel more stress, leaving them irritable (Hannaford, 2005; Kraut et al., 1998). A traditional classroom environment of stagnate seating could set up children for misbehavior. Sitting at a desk for hours during class and listening to teachers instead of animated electronic devices may be a difficult adjustment to expect from children. This need for stimulation may be partially fulfilled by the sensory stimulation found in movement on therapy balls. With therapy balls, there is less need for children to seek extraneous stimulation by getting up from their seats or misbehaving (Fedewa & Erwin, 2011). The active seating enabled by therapy balls may meet children's stimulation requirements. This potentially translates into less disruptions in classroom behavior and more content children who are better able to monitor themselves

Since the other remaining Behavior Rating Inventory of Executive Function (BRIEF) subscales did not show significant increases in executive functioning, it should be noted, however, that the overall measure of executive functioning—the Global Executive Composite score—showed improvement in performance when the children were on the therapy balls versus sitting on chairs. The improvement, however, was not large enough to register as significant.

Self-Esteem. According to the results of this study, children improved significantly in self-esteem. This was evidenced by the significantly higher self-esteem scores on the Culture Free Self-Esteem Inventory - Third Edition (CFSEI-3) when the children used therapy balls. The fifth hypothesis predicting increased self-esteem with therapy ball use was upheld. Based on results showing improved working memory, decreased hyperactivity-impulsivity, and increased processing speed, this finding is consistent with researchers, Baumeister et al. (2003), who believe that good school performance is a predictor of enhanced self-esteem. Specifically, in terms of reduced hyperactivity-impulsivity, the results of the present study align with those of Frankel et al. (1999) who found that when children's hyperactive behavior improved, their self-esteem improved significantly. Furthermore, the current study's results correspond to another study showing that when children made improvements in disruptive behavior, their self-esteem also improved (Larkin & Thyer, 1999).

Gender. According to the results of this study, there were no significant gender differences pertaining to level of improvement of executive functioning when using therapy balls. The last hypothesis predicting that boys would improve more than girls when using therapy balls was not upheld. Since boys have traditionally been diagnosed, more than girls, with disorders relating to executive functioning deficits (Adams, 2007; Bartley, 2006; Biederman et al., 2002; Cortiella & Horowitz, 2014; Hannaford, 2005), one might be surprised by these results. Since the population used in this study, however, was mainly typically developing children, this may explain the discrepancy. If the population had consisted of more atypically developing children, the results may have been significant. This is possible since the current study's results did reveal a trend showing larger improvements in boys' executive functioning performances versus girls' performances when sitting on therapy balls.

Social validity. In evaluating preference for therapy balls or chairs, the results revealed significance in the children's desire to use therapy balls over chairs. This corresponds to the research done by Kercood and Banda (2012) and Schilling et al. (2003) whose studies also showed children preferring therapy balls instead of chairs. When verbally asked, many of the children believed that it was easier to pay attention in class and they liked being able to move on the balls.

Conversely, the results showed that all three teachers preferred chairs over therapy balls. Teachers expressed opinions such as "the balls rolled around the classroom," and "the balls took up a lot of space," and "some of the children fell off of the balls," and "keeping track of the balls customized to individual students was difficult when students changed seating arrangements for reading groups and other subjects." This contradicts past research showing that teachers preferred therapy balls (Fedewa & Irwin, 2011; Schilling & Schwartz, 2004; Schilling et al., 2003).

Limitations. One limitation of the study was the use of a subjective assessment tool, the Behavior Rating Inventory of Executive Function (BRIEF). Since the teachers rated the students' behavior on the BRIEF, the results were potentially biased. For example, as explained earlier, executive attention is synonymous with working memory capacity (Engle, 2002). In this study, teachers did not *observe* significantly improved attention via the Working Memory subscale of the BRIEF. When the teachers rated the children on the chairs and therapy balls, they were ranking them on a 3-point scale (never, sometimes, often) based on observed behavior. Statements such as "has a short attention span" or "has trouble remembering things, even for a few minutes" were subjectively rated by the teachers. Attention, however, in theory, could also be measured via actual performance on the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV) Working Memory subscale. On this assessment, the students *experienced* significantly improved attention. The WISC-IV measured attention via quantifiable activities. For instance, one activity measured children on their ability to listen to a non-sequenced list of number and letters; then they were to recite them back to the assessor in the proper, sequential order. The WISC-IV scores, which displayed objective student-experienced results, in essence, conflicted with the teachers' subjective scores on the BRIEF.

Additionally, teacher C's ratings were more extreme than the other teachers. This necessitated the decision to delete her scores from the analysis. Since teacher C was located at a different campus and her classroom size was physically much smaller than Teachers A and B, this may have negatively influenced her therapy ball ratings. Teacher C's class size was 15 feet by 23 feet whereas teacher A and teacher B each had classrooms that were 25 feet by 30 feet. The balls are large and somewhat cumbersome, making it difficult to navigate around them in tight spaces. This hindrance, however, did not seem to negatively affect the children since 100% of the children in Teacher C's class preferred the therapy balls.

A second limitation was the age of children. Since the V.P. of Academic Affairs for the school felt that there has historically been a challenge regarding first-graders' naturally wiggly behavior, she wanted the research to be conducted on children in the first grade. She thought the therapy balls in first grade would be a nice bridge from having a lot of "floor time" in kindergarten to sitting at desks in second grade. Although, this was a natural fit since first-graders are organically more fidgety, this age limit curtailed the ability to use several assessment tools. Since many assessment instruments are for children 8 years old and above, it was difficult finding assessments appropriate for 6- and 7-year-olds.

A third limitation was trying to conduct a research study with children at a private school while maintaining a low profile and not disrupting the natural school rhythm. It would have been ideal to augment the research by having parents fill out questionnaires as well. This may have disturbed the school culture, however, by trying to involve the parents, plus potentially produce a confounding variable if the parents influenced their children either negatively or positively. The goal was to preserve a non-descript and neutral demeanor.

A final limitation was the number of children in the study. While this study was larger than most research pertaining to this subject, the results of 44 children are difficult to generalize to a broader range of children. Additionally, since there were no children actually diagnosed with executive functioning deficits, comparisons between typically developing children and those with executive functioning deficits could not be made. Although, this research showed all of the children significantly improving in many areas, it would be beneficial to corroborate or negate past research which showed atypically developing children improving more.

Future research. Many promising results were revealed in this study, yet there are many questions that remain unanswered. It appears that typically and atypically developing children improved in executive functioning skills when using therapy balls. Some researchers believe that attention deficits are related to sensory modulation deficits and that physiological processes need to be able to adapt to new sensory information (Schilling et al., 2003). Historically, the Optimal Stimulation theory formed the basis for this belief. The works of Hebb (1955) and Leuba (1955) posited that people naturally seek different levels of stimulation suitable to individual needs. The freedom to move on therapy balls allows for this adaptation. Furthermore, research has shown that many children with attentional issues have increased sensory requirements (Pfeiffer, Henry, Miller, & Witherell, 2008). This naturally makes sensory items, such as therapy balls, a good fit for these children. Since the present research shows that typically developing children also perform better when on therapy balls, it could benefit future researchers to assess levels of sensory systems in all children as they relate to therapy ball usage. Moreover, since one of the sensory systems, vestibular seeking stimulation—the sensation of gravity and movement—is characteristically more extreme in younger children such as babies and toddlers, research studying the application of therapy ball use for different ages groups would be helpful. It is plausible that the present study revealed more promising results because the research focus was on first-graders and not older children.

It is also possible that some children perform better on therapy balls due to their particular learning style. Research has shown that children whose learning style is based in a kinesthetic nature have more increased attention compared to other learners when using hand-held stress balls (Stalvey & Brasell, 2006). This same phenomenon may apply to kinesthetic learners on therapy balls. It would be advantageous to study children's learning styles as they relate to performance on therapy balls.

Another area worth exploring could be in deciphering between improvements in visual versus auditory processing speed. Since there may be more improvements in visual processing speed due to increased proprioceptive feedback from therapy balls, it would be beneficial to address this idea in more detail. It would behoove researchers to compare these constructs as they relate to typically and atypically developing children.

Finally, since the teachers in this study preferred chairs in the classroom, another movement tool could be explored. Using a smaller device such as wiggle cushion which allows children to move while sitting at their desks may be a more teacher-friendly option. The wiggle cushion is smaller and sits directly on top of the students' chairs.

Additionally, wiggle cushions are approximately half the price of therapy balls, making them more attractive to public and private schools due to budgeting constraints.

A preliminary study showed a small to medium effect size in executive functioning improvement for children using a wiggle cushion (Pfeiffer et al., 2008). This cushion would be an option for teachers and schools if they are opposed to therapy balls, however, more research in this area is needed.

Summary. The results of this experimental within-subject study support the use of therapy balls in the classroom in lieu of chairs. Children significantly improved in working memory and processing speed as measured by the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV). Additionally, the children displayed significantly reduced hyperactivity-impulsivity behavior and improved monitoring abilities as measured by the Behavior Rating Inventory of Executive Function (BRIEF). Furthermore, despite the teachers' preference for chairs, the children preferred the therapy balls and had significantly improved self-esteem when using them. Moreover, where past research mainly revealed students with attention deficit hyperactivity disorder (ADHD) or autism spectrum disorder (ASD) benefitting most from therapy balls, the present study showed that typical and atypical children significantly improved. Further research is warranted, however, to find out what specific phenomenon is producing these results. Variables such as sensory differences, age of children, learning styles, and proprioceptive feedback should be explored to extend the research. Additionally, other movement tools such as wiggle cushions may be a more teacher-friendly and affordable option, but need to be researched further. Ultimately, this study has shown that classroom environments can be changed to give all children more freedom of movement when seated, resulting in more optimal learning, and increased self-esteem.

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Appendix A

Questionnaire 1

Questionnaire of Teachers

Child__________ **Circle One**: Pre-intervention Post-intervention

Rate the Child's Behavior/Performance	**Problematic**		**Average**	**Above Average**	
Relationship with Peers	1	2	3	4	5
Reading Skills	1	2	3	4	5
Math Skills	1	2	3	4	5
Written Language Skills	1	2	3	4	5

Appendix B

Questionnaire 2

Questionnaire of Teachers (post-intervention)

Which do you prefer that the children
sit on during class? Chairs_____ Stability Balls_____

Appendix C

Questionnaire 3

Questionnaire of Children (post-intervention)

Name ___________________________________

Which do you like sitting on during class? Chairs_____ Stability Balls_____